



from the July 24, 2003 edition - <http://www.csmonitor.com/2003/0724/p02s01-stss.html>

The quasar that reawakened the universe

New research and a distant trace of dust converge to transform cosmic evolution.

By [Peter N. Spotts](#) | Staff writer of The Christian Science Monitor

New measurements of a brilliant galactic beacon nearly 13 billion light-years away are unveiling a critical period in the evolution of the universe.

Astronomers are reporting Thursday that they've discovered surprisingly vast amounts of dust and carbon-monoxide gas in the active young galaxy, making its mass comparable to those of far larger galaxies in a much older universe. The results suggest that stars, planets, and, in particular, galaxies, formed faster and more furiously than was thought.

In addition, researchers say the galaxy - the most distant quasar discovered so far - has been caught in the act of helping reawaken the universe from what cosmologists call its "dark ages," a period during which new stars' and galaxies' light is thought to have been quickly absorbed in a dense fog of neutral atoms.

Radiation, meet the Big Bang

The quasar's radiation began its journey 870 million years after the Big Bang's enormous release of energy. And it appears to have cleared a region of heightened transparency for itself some 30 million light-years across.

"This is not just seeing the farthest known object, but the farthest knowable object. This is the joy of it: The data are telling us: You are here, this is where it all started," says Chris Carilli, an astrophysicist at the National Radio Astronomy Observatory's Very Large Array in Socorro, N.M., and a member of the international collaboration reporting its results in Thursday's issue of the journal *Nature*.

"Ten years ago, no one would have thought that huge masses of dust and heavy elements already existed so soon after the Big Bang," says Frank Bertoldi, an astronomer with the Max Planck Institute of Radio Astronomy in Bonn, Germany, and another collaborator on the project.

On a more practical level, Dr. Carilli adds, this work - which pushes telescopes and data analysis to their limits - demonstrates that with the next decade's new generation of radio and infrared telescopes, astronomers will be able to plumb this critical period in cosmic evolution.

The new quasar on the block

The quasar, named J1148+5251 for its location in the sky, came to light in January when researchers poring over data from the Sloan Digital Sky Survey found it.

Once astronomers heard the news, they raced to make more detailed observations, often shoving aside scheduled projects in favor of the new research.

By April, a team led by Chris Willcott at the Herzberg Institute of Astrophysics in Victoria, British Columbia, had determined that the black hole at the heart of J1148+5251, and the powerhouse driving the quasar's intense light output, was 3 billion times as massive as the sun.

At the same time, the US-European team and one from Britain independently measured unexpectedly large amounts of dust associated with the quasar. That dust - a key set of microscopic Legos for forming larger objects such as asteroids and planets - provided tantalizing evidence that star and galaxy formation may be occurring faster than was thought.

Two ingredients in dust are silicon and carbon - heavy elements forged in the hearts of enormous hot young stars. These stars end their brief lives in explosive flashes known as supernovae, which shower freshly minted atoms that throughout the interstellar medium.

Man can't date by dust alone

But dust alone can fool you, notes Kate Isaak, an astronomer at the University of Cambridge's Cavendish Laboratory in England and a member of the British team reporting dust associated with the quasar. She says it's possible to establish an estimate of the dust's position in space relative to the quasar. But it can be difficult to distinguish between dust *at* the quasar and dust somewhere in the line of sight in between Earth and J1148+5251.

Carbon monoxide, however, has a characteristic signature on the electromagnetic spectrum and thus can indicate distance.

"That's why this is significant," she says. The carbon-monoxide measurements represent unambiguous evidence for a furious pace of star formation and destruction through supernovae.

And, she adds, carbon monoxide is a good tracer for hydrogen - the ingredient that fuels stellar furnaces. The US-European team estimated that J1148-5251 holds 20 billion solar masses' worth of molecular hydrogen, enriched with heavier elements such as carbon, oxygen, and silicon.

Dust bunnies - or dust boons?

Yet the dust in J1148-5251 is a puzzle. Current notions hold that galaxies take a billion years or more to accumulate dust between stars. In this scenario, J1148+5251 is too young to have so much dust.

But the answer may lie in work published in last week's issue of *Nature*. Inspired by the unusually quantity of dust in J1148+5251, a team led by Loretta Dunne, an astronomer at Cardiff University in Wales, analyzed the dust content of a supernova remnant - and found that supernovae can produce more dust than they've typically been given credit for.

"If that holds true," says Carilli, "it would solve our problem."

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